MEMORANDUM
Water Resources Technical Advisory Committee

TO: Board of Supervisors

FROM: Gem Bingol, WRTAC Chairman

THROUGH: T. Hemstreet, County Administrator
C. Yudd, Assistant County Administrator and Liaison to Transportation & Land Use Committee

SUBJECT: Technical evaluation of pollution control measures in proposed Chesapeake Bay Preservation Act ordinance

DATE: September 8, 2010

The Water Resources Technical Advisory Committee (WRTAC) presented an update on priority recommendations for a comprehensive watershed management program at the July 21, 2010 Transportation and Land Use Committee. The Transportation and Land Use Committee requested that WRTAC provide an assessment of the County's proposed Chesapeake Bay Preservation Act ordinance to the Board of Supervisors for their September 21, 2010 meeting. WRTAC has reviewed information concerning the potential effects upon water quality of implementing the pollution control measures specified in the proposed ordinance. The three pollution control measures under review are:

(1) Vegetative buffers for perennial streams;

(2) Maintenance pump-outs of septic tanks in sewage treatment systems; and

(3) Increased erosion and sediment control requirements.

Details of these requirements are provided in the County's draft "*Chesapeake Bay Preservation Ordinance*" document dated April 30, 2010.

The WRTAC recommends the implementation of these three measures by Loudoun County as part of the proposed CBPA ordinance, based on sound technical research documenting their effectiveness to limit the entry of pollutants, particularly nitrogen, phosphorous, and sediment, into Loudoun County receiving waters. The table below outlines the benefits provided by the three recommended pollution control measures. This information is supported by a discussion of the technical justification and rationale for these benefits, as well as a list of technical references documenting their success, in the following sections.

Table 1. Benefits gained from the WRTAC- recommended pollution control measures proposed in Loudoun County's draft Chesapeake Bay Preservation Act ordinance.

Pollution Control Measure and Resulting Benefits

(1) Vegetative Buffers for Perennial Streams

Default buffer width of 100 feet each side of stream [*see section 1222.05(s) in draft CBPA ordinance*]; Research sites typically include native, woody, deep-rooted plants and grasses.

Buffers effectively filter sediment, nutrients such as nitrogen and phosphorous, and pesticides in runoff, thereby reducing their potential to enter Loudoun's streams.

- Most practical buffer designs can effectively remove up to 50-80% of nutrients, sediment, as well as some pesticides from land runoff
- Buffers help to protect livestock and human health from harmful levels of nitrogen in surface and ground water
- Reduced phosphorous in surface waters prevents nuisance algae growth and maintains balanced aquatic food chains
- Buffers offer a back-up measure to provide added filtering capacity to the other recommended pollution control requirements of septic pump-outs and erosion and sediment control for construction sites
- By decreasing water pollution, buffers help reduce water treatment costs

Buffers also offer additional benefits beyond trapping sediment and pollutants, such as:

- Provide wildlife habitat
- Stabilize stream banks during floods by trapping and retaining sediment in vegetative root structures
- Reduce flooding and erosion in downstream areas by slowing the velocity of stormwater flows
- Shade and thereby cool stream and river water for aquatic life, particularly native fishes
- Provide leaf matter as food for aquatic life

(2) Septic Tank Pump-Outs Required Every Five Years

[*See section 1222.17(a)iv in draft CBPA ordinance*]

- A properly functioning septic tank removes up to 30% of the nitrogen from raw wastewater inflow
- Properly functioning septic tanks allow only liquid to flow to the associated drainfield, thereby enabling treatment of biologic contaminants and further reduction of harmful levels of nitrogen
- Pump-outs are standard maintenance practice and enable proper septic tank and drain field function
- Failure to pump-out tanks results in sludge buildup in the tank and reduced treatment of wastewater
- Excessive sludge in tank overflows to drainfield lines and clogs soils causing permanent drainfield failure leading to groundwater/surface water contaminated with pollutants and pathogens
- Failed drainfield requires expensive replacement in a "reserve area", maintenance-intensive non-conventional treatment system, or public sewer
- Pump-out maintenance is less costly to taxpayers than replacement. As an example, a multi-million dollar extension of the Hamilton public sewer system, paid for by taxes, was required to address failing drainfields.
- Given the fractured bedrock geology of much of western Loudoun, and the presence of porous limestone deposits in northeastern rural Loudoun, there is risk that high nitrate concentrations in groundwater beneath failing septic drainfields could migrate to other ground and surface water bodies.
- Local drinking water wells are at higher risk of nitrate contamination without pump-out requirements.

(3) <u>Reduce Minimum Area Requiring Erosion and Sediment Control Measures</u> [*See section 1222.17(a)ii, and iii of draft CBPA ordinance*]
• Erosion from a bare soil construction site is 2,000 times greater than from forested land • Erosion from a bare soil construction site is 200 times greater than from grassland • Excessive sediment deposition in Loudoun streams and ultimately the Potomac River and Chesapeake Bay can adversely impair aquatic life • Loudoun County offers means for the development and implementation of practical, non-engineered E&S control plans for homeowners and small projects. • Implementation of these E&S control plans is a proactive and cost-effective means to protect water quality and educate the public on appropriate measures to protect Loudoun waters. • Turbidity in surface water sources due to elevated levels of sediment increases surface water treatment costs.

TECHNICAL JUSTIFICATION AND RATIONALE

<u>Perennial Stream Buffers</u>

Stream buffers, or vegetated strips of land adjacent to a stream or river bank, are proposed for perennial streams with a buffer width of 100 feet on each side of the stream. Stream buffers act as a "filter" between the stream and the land beyond the buffer. Buffers can be effective at filtering sediment and contaminants that may be associated with soil particles [Gilliam and others 1997, cited in Klapproth and Johnson 2009], as well as with removing nitrogen from surface water runoff and shallow groundwater. While buffers are less effective for long-term removal of phosphorous, they can still be an important sink for this nutrient [Parsons and others 1994, cited in Klapproth and Johnson 2009].

Buffer effectiveness typically varies with:

- **Buffer width** - Wide buffers are generally better than narrow ones, particularly over extended time periods [Cooper et al. 1987 and Lowrance et al. 1988]. Although narrower buffers can reduce pollutants, 100 feet is often considered a reasonable width for effectiveness [summary of various studies provided in Wenger 1999].
- **Buffer continuousness** - Buffers with gaps or significantly narrowed areas can lead to unfiltered water discharging into the stream which compromises the buffer's effectiveness [Rabeni and Smale, 1995].
- **Buffer vegetation type** – Buffers composed of native, woody, deep-rooted vegetation are considered best because they help filter surface water, remove nitrogen from shallow groundwater, and withstand and slow flood water. Grasses can also be effective buffers, especially when combined with woody vegetation [Lowrance et al. 1997; Shields et al. 1995; Peterjohn and Correll 1984].

Buffer effectiveness can be limited by concentrated stormwater flow (higher velocity/ volume in a more confined area) versus sheet flow (runoff over a broad area and lower velocity). Excessive sedimentation that accumulates in the buffer faster than the buffer plants can adapt to the increased soil depth can also reduce the buffer's effectiveness. These and other conditions that may occur on the land adjacent to the buffer can affect how the buffer will perform as a pollution mitigation measure [Lowrance and Sheridan 2005].

Research has shown that most practical designs for riparian buffers can achieve removal efficiencies of nutrients/pesticides/sediment anywhere from 50-80% [Daniels and Gilliam 1996; Arora et al. 2003].

Finally, it should be noted that riparian buffers have additional benefits beyond trapping sediment and nutrients. These benefits include providing wildlife habitat, stabilizing stream banks, shading stream water which keeps it cooler, and providing leaf matter as food for aquatic life [NRC 2008].

Septic System Pump-Outs

The proposed ordinance requires that traditional individual sewage disposal systems (i.e., septic tank and infiltration field) have maintenance pump-out of the septic tank performed at least once every 5 years. EPA's *Onsite Wastewater Treatment Systems Manual* [USEPA 2002] indicates that a properly functioning septic tank removes nitrogen from the raw wastewater inflow. Up to 30 percent reduction of nitrogen in the septic tank is cited by Seabloom, R.W., T.R. Bounds, and T.L. Loudon (2005). An improperly operating septic tank and drainfield can discharge both nitrate and pathogens (fecal coliforms) directly to groundwater or surface water. Particularly in areas where the thickness of soil and saprolite overburden is minimal (that is, shallow depth to bedrock), pollutants in groundwater beneath a septic field underlain by fractured bedrock or karstified limestone may migrate with little attenuation to adversely impact other water bodies, including nearby streams

A properly operating drainfield is essential for the treatment of sewage. One of the primary causes of failing drainfields is the overloading of the septic tank and discharge of sludge and solids into the drainfield. This results in clogging of the soil that can lead to ponding of untreated sewage effluent directly on the surface. This, in turn, can run off to pollute surface water as well as threaten human health with pathogens [USEPA 1996]. Depending on the site topography, hydrogeology, and well construction, local drinking water wells may also become contaminated [USEPA 2002].

Failed drainfields are expensive to replace and contaminated groundwater may have costly ramifications for a community. Locally, the Town of Hamilton secured a $2.6 million dollar, 20 year loan (financed by residents through a special sewer tax district) to extend the Town's sewer lines to 160 properties with failing septic systems (Town of Hamilton 2003).

Erosion and Sediment Control

The threshold for a grading permit and subsequent erosion and sediment control measures is proposed to be reduced from 10,000 square feet (ft^2) for residential development projects and 5,000 ft^2 for commercial projects to 2,500 ft^2 for both development scenarios. Erosion from the bare soil of a construction site is approximately 2,000 times greater than from forested land and 200 times greater than from grassland [USEPA 1973]. Erosion and resulting sediment deposition into Loudoun's streams and thereafter into the Potomac River and Chesapeake Bay impacts water quality and the aquatic life that depends upon such quality to survive. Thus, regulating construction sites to the extent possible is a proactive means to reduce such impacts to water quality and educates the public on appropriate measures to sustain the County's water resources. The County has developed and implemented a means for non-engineered Erosion and Sediment Control plans as a service for homeowners and small projects and a prioritized inspection system that enables the staff to perform inspections at a frequency that reflects the complexity of the project.

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